Not too long ago, those involved in research and development for technical apparel took a closer look at sleeping bags. What seemed appropriate for coping with moisture in sleeping bags might work just as perfectly in functional apparel: synthetic filling. Product managers responsible for sleeping bags seem to have undertaken the process in reverse: Why not borrow the idea of seam - and stitchless production to improve the performance of sleeping bags?

Seams – some time ago!

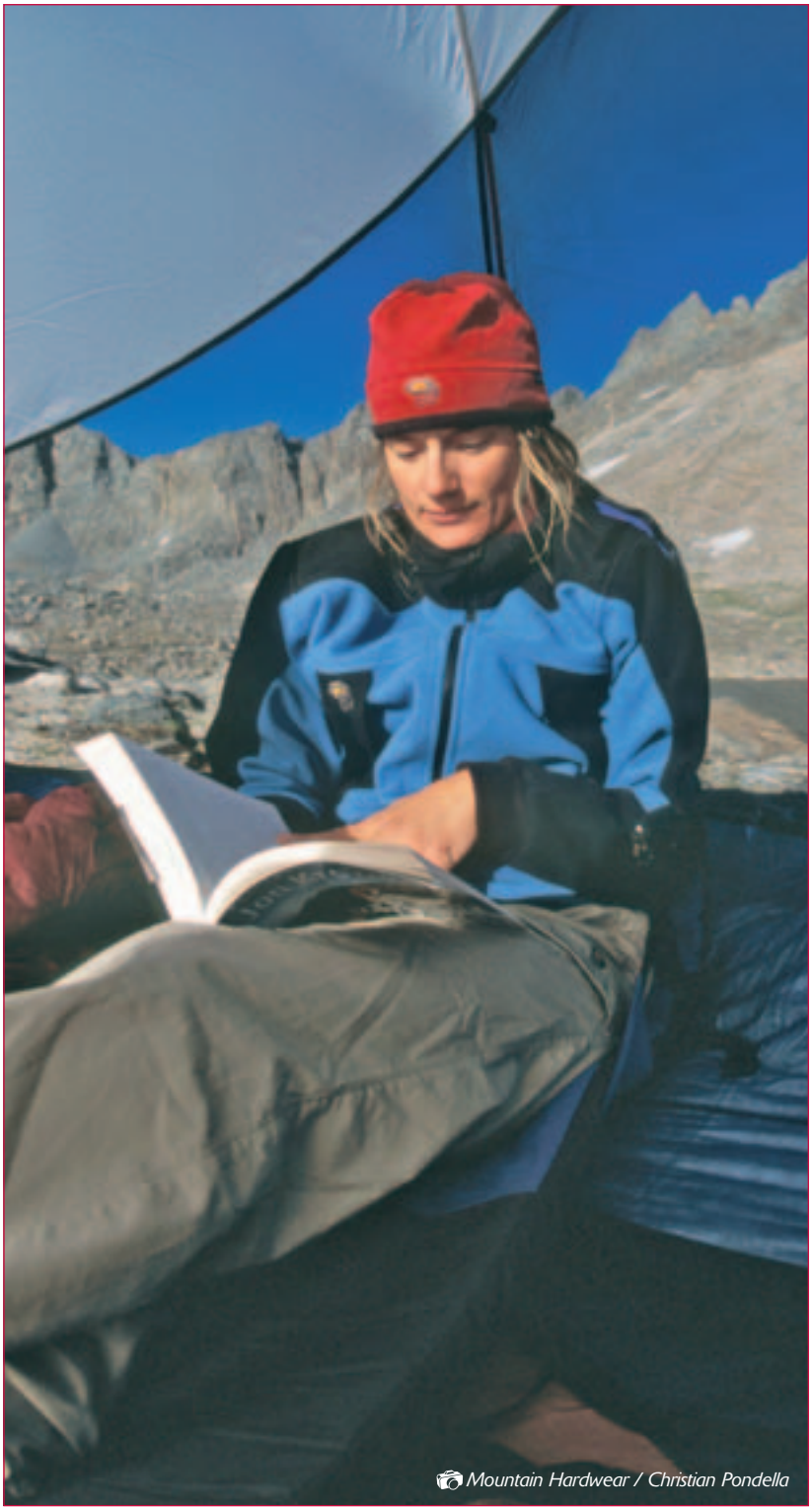
For years and years, the only point of interest about sleeping bags was the filling. Down or synthetics, fill-power, compression volume, and temperature rating, the 'stuffing' defined warmth and use. The only other issue capable of arousing interest was the way the fill was fixed within the bag. With down this meant the way the baffles were sewn, with synthetics one focused on layering or shingle technology.

Recently, more defined testing methods have changed the perspective towards sleeping bags. Insulation is not only a matter of fill-power or baffle cut. Sleeping bags are seen as an entity. Fabric options, differential cut, tailored fit or seams all contribute to the warmth and comfort of a sleeping bag and tests have shown that even the stitch-holes reduce the temperature rating. After seamless construction of panniers, packs, jackets, and tents, now sleeping bags are substituting sewn seams with other methods.

Seamless is said to be one of the core technologies of the early 21st century. Yet, in terms of production, seamless can mean anything: gluing, laminating, bonding, welding, knitting. Is seamless only another hype-word to arouse attention? Far from it! Managing to reduce seams does generally increase performance.

Swiss pioneers

The Swiss outdoor brand Exped from Zurich is an astonishing think tank in outdoor research and development. As a company of only thirteen people, Exped has not only managed to achieve a European Outdoor Innovation Prize – the most sought after outdoor prize in Europe – for the invention of its down air mattresses; it is the first company worldwide to present a sleeping bag collection without seams on the complete shell. In spring/summer 2000 season, Exped launched the 'WaterBloc' (WB)-series for sleeping bags: Ibis WB, Woodpecker WB, Swan WB and Artic Goose WB cover a range from everyday camping to expedition mountaineering. In WB technology the outer baffle is glued to the shell fabric. Exped WB-series sleeping bags use Pertex's waterproof Endurance (1,500 mm water column) fabric that is, according to Standard-Test BS3546 Part 4 1991, 90% vapour permeable.



Mountain Hardwear / Christian Pondella

An end to the agony

"Thanks to WB," says Exped CEO and product manager Andy Brun, "the agony of choosing between down- or synthetic-filled sleeping bags is over." By this, Brun means the dilemma between highly compressible, soft, light and exceedingly warm goose down-filled bags and the synthetics that outperform down only in wet conditions. Exped solved this problem by replacing sewn seams with glue-welded seams, creating a sleeping bag that sheds off any water and keeps the down from getting lumpy. Because of the open hood, Exped actually agrees that the bags are not intended for use in rain, but rather in wet conditions under tarps, single-wall shelters, snow caves and igloos where melt water or wind blown moisture had, up to then, rendered the down less efficient and made users turn towards heavier, bulkier, and less comfortable synthetic bags. Nevertheless, for pouring rain, Exped even offers a WB-Rainhood cover or advises the use of a waterproof jacket as a cover.

Next to the ability to protect the down from moisture, avoiding thousands of stitching holes with a virgin waterproof surface has some further advantages for the performance of a sleeping bag. First, Exped's welded seams are stronger and add durability to the fabric due to a double seam-layer. Traditional seams weaken the fabric because of saw tooth holes every few millimetres. Second, welded seams prevent heat loss by stopping warm air from being pushed out of the bag and hindering cold convection air to enter the bag. And third, which again and again astonishes Brun, the WB-technology reduces the problem of condensation in the bag. Nobody had actually accounted for this advantage, but field tests in various regions have illustrated that WB-series bags have far fewer moisture problems than the traditional combination of a sleeping bag and bivouac sac. Welded seams increase the warmth-to-weight ratio of down bags even further.

Worldwide acceptance

Exped had its 'WaterBloc' technology patented, which has turned out to be highly necessary. Today companies from the US, Europe to New Zealand and others have, in one way or another, bought the licence. The first company to use the seamless technology for its own down expedition sleeping bags was Mountain Hardwear – which for the small Swiss company Exped equated to something not far from being knighted. Mountain Hardwear uses it in connection with its waterproof Conduit SL shell fabric (2,000mm water column/20,000mg breathability) to protect the down from dampness and vapour and also to reduce cold spots.



Macpac Epic.
Macpac

Mountain Hardwear is not the only US company to use seamless. The American sleeping system specialist Big Agnes, from Steamboat Springs, Colorado, calls its system 'Seam Zero' and deploys it in its Shield series sleeping bags.

In Europe, the British outdoor and mountaineering company, Berghaus, Sunderland, UK, is developing a sleeping bag range using WB-technology. This is astonishing in a double sense. First, the sleeping bag range is the first Berghaus has produced and second, it shows that Berghaus is aiming right at the heart of the sleeping bag business.

The German outdoor company Vaude, based in Tettnang, believes seamless technology is a promising market. Since the early 1990s Vaude has gained experience through producing high-frequency-welded bike panniers and waterproof packs and bags. And only recently Vaude started to weld bike and mountaineering packs. In regard to sleeping bags, Matthias Kimmerle, product manager for sleeping bags at Vaude, admits that the company is not using seamless at present due to the Exped patent. But he stresses, "We are good at high frequency, ultrasonic and, of course, bonding by means of heat and pressure," a clue that Vaude is working hard to develop its own technology. Kimmerle adds, "For sleeping bags I would concentrate on ultrasonic technology."

Macpac, of Christchurch, New Zealand, is another mountaineering company that has bought the WaterBloc-licence for sleeping bags. In contrast to Mountain Hardwear and Exped, Macpac focuses on a more specific target group - lightweight mountaineering and adventure racing. Macpac's Stitch Free- (SF-) range of sleeping bags don't exceed the 1,000g weight limit and are third in line regarding their temperature rating – a minimum 0°C comfort limit, according to European Standard EN 13537. Macpac also uses Pertex's waterproof Endurance shell fabric.

Brun points out a small difference between Exped seamless technology and all of the others, "We double weld our seams. That has the advantage that wear and tear will definitely not harm them." Since a single or double weld is not laid down by licence, the companies are free to choose.

Seamless with synthetics

The Exped development applies only to down-insulated bags. Nevertheless, seamless technology is also interesting for synthetic filling – even though it is not as susceptible to moisture as down. Darren Burrell, product manager at British sleeping bag specialist Snugpak, based in Silsden, West Yorkshire, points out the advantage, "You have to sew through synthetics to ensure your insulation does not go walkabout around your sleeping bag when its being washed or, even worse, when being used. Advances in bonding technology mean that we can rely on the resin we use to hold the insulation exactly where it should be." By the way, all UK-made sleeping bags from Snugpak are only sewn at the zip and neck seams, but Burrell wouldn't call them seamless. There must be more to it.

Next to seamless in down bags, Mountain Hardwear uses seamless constructions in two of its synthetic sleeping bag ranges. The 'Expedition'-series bags with the Conduit SL outer fabric are shingled designs. The outer part of the shingle is heat-glued to the shell, similar to the baffle in down bags. In its 'All Mountain' line, Mountain Hardwear has developed a welded layer construction. This is only possible because of the continuous filament construction of the insulation. The top and bottom layers are welded intermittently to the shell and the lining, resulting in an entirely seamless outer and inner construction. The welding of the layer construction is ultrasonically activated.

Mountain Hardwear's three specifications for seamless technology are: lower compression of the fabric to reduce cold spots; maximised loft for higher insulation performance; and stabilised insulation that stays where it is needed. Waterproof performance is not generally wanted as the use of Micro Ripstop as a shell fabric in the 'All Mountain'- line goes to show.

A similar technique is used by the Swiss-Norwegian sleeping bag brand Ajungilak from Seon, Switzerland. Instead of sewing the layered fillings and creating cold spots, it has turned to a system of intermittent lamination. Ajungilak, which in the past reduced the loss of performance through convection by using a loose outer fabric on all of its synthetic bags, is continuing this path with new lamination technology. The layers of synthetic insulation are only fixed to the lining, which – from Ajungilak's field and lab testing – is sufficient to last the lifetime of a sleeping bag. Bernhard Ackermann, product manager at Ajungilak even argues that a loose shell adds performance: "As the cover is free to move, the fabric is less prone to damage from abrasion and tearing."

Marmot Mountain, Santa Rosa, California, is also following this new trend. This summer, it presented a two-in-one bag, the 'Pounder Bivy', with laminated insulation (PrimaLoft Sport) and the waterproof Pertex Quantum Endurance shell. Marmot sees this technology as a combination of a lightweight sleeping bag and a bivy bag – only much lighter, less hassle to use, and with better overall breathability. Although the 'Pounder Bivy' could be interpreted as Marmot's first seamless sleeping bag, the way the company markets it, it seems to be more of a special interest sleeping bag to round off the line.

What and how seamless technology?

Seamless Technology paraphrases two different technologies. In base-layer apparel it means seamless knitting, a process of circular knitting that leaves a finished garment without side seams. For hardware products, i.e. sleeping bags, packs and tents, or shell apparel, seamless refers to a welding or bonding technology, which uses an agent to attach two pieces of fabric and eliminates the need for sewing.

Again two methods dominate. The first uses an adhesive film and heat to glue or laminate the two layers together. The second method attaches two fabrics by using ultrasonic technology. Ultrasonic involves creating and channelling high frequency vibratory waves that build up heat in the synthetic fabrics to create the bonding.



Artic Goose and Woodpecker sleeping bags from Exped's 'WaterBloc' range.

Exped

The Exped WB-technology uses the adhesive film method to connect the fabric layers. Brun, a thirty-year veteran in the outdoor business, has a simple explanation, "Adhesive film and heat is an old technique, nearly 20 years old," and he adds, "I know it's a technology that works well." Brun says that he likes to follow new ideas, but not for the sake of them being new. "The margin for error with ultrasonic welding is very narrow and at the moment, ultrasonic technology is still in its infancy."

Salewa from Munich, Germany, has not introduced seamless sleeping bags yet, but it presented its first seamless tent a year ago – also based on adhesive film and heat. Bernhard Schnaus, product manager hardware at Salewa, shares Brun's opinion, "Everyone is experimenting with seamless technology, especially ultrasonic and high frequency welding, but nobody will really be ready for the next five years." The only exceptions are very thick fabrics like PVC, tarpaulin or double-coated Cordura as Ortlieb uses for its bike panniers.

Erik Hamerschlag, product manager hardware for Mountain Hardwear, states that more time will be necessary due to a lack of experience with hardware fabrics. "The problem," Hamerschlag says, "is mainly teaching factories about new construction methods and developing specialised machinery to execute the designs." Generally speaking, Hamerschlag sees an advantage in seamless apparel. "Since clothing is a much bigger industry, the outerwear manufacturers have been much quicker to invest in new machinery. The same is true of the companies that make the machines."

As one of the 'pioneers' in gluing Mountain Hardwear's head of design, Paul Kramer had this to say about glue's future at a recent Bemis design forum, "It's the new way of putting products together. It's exciting. Is it a fad that will last two-five years and be gone? No."

Bemis Worldwide is a US manufacturer, long recognised for providing adhesives, coatings, and specialty films. In its 95-year history, it has seen its bonding specialty go from mundane applications to its position today as a viable and important means to better enjoy one's outdoor adventures. Its 'Sewfree' adhesive film is being used by a myriad of high-end brands in a variety of outdoor apparel and gear.

"I think designers are just beginning to understand the unique ways you can assemble garments and gear using adhesives when you are not limited by things such as pattern shaping…there's another aesthetic evolution to come which will really drive this technology forward," says The North Face's product director outerwear, Damien Huang.

Sleeping bags are an ideal Sewfree application as they represent the ultimate performance test that exposes the superiority of a bonded construction over a stitched construction. According to Kramer, some gluing is for performance and some for features. He makes the point that a welded seam is very durable and easy to repair. Most of all, in a sleeping bag he notes that "the threads get cut by toenails". Now this is a feature and benefit that every sleeping bag user can relate to.